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Geometry optimization for GPS navigation

McKay, J.B.   Pachter, M.
Air Force Inst. of Technol., Wright-Patterson AFB, OH;

Abstract:
This paper presents the analysis and numerical optimization of the geometry of an inverted pseudolite positioning system. First, the effect of geometry on the system's accuracy is examined. The geometric dilution of precision produced by typical system geometry is considered, and an alternate measure of the geometry effect, the condition number of the "visibility" matrix H, is introduced. Next, the optimization of the system's geometry is presented. The simplified problem of optimizing the geometry with respect to a stationary pseudolite is solved. The results of a numerical optimization are presented and both the effectiveness of the optimization routine and the usefulness of the resulting system configurations are discussed. Finally, design guidelines for good geometry are listed

Index Terms:
Global Positioning System   aircraft navigation   attitude control   geometry   matrix algebra   optimisation

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A new pseudolite battlefield navigation system

Farley, M.G.   Carlson, S.G.

Abstract:
Rockwell Collins is developing a pseudolite (PL) based Battlefield Navigation System (BNS). (Farley, 1998). The BNS is intended for use as a navigational aid when GPS signals are unavailable or being interfered with. This paper will present a new PL navigation system concept based on the Rockwell Collins Personal Computer Signal Generator (PCSG) satellite simulator product line. The PL navigation system requires modifications to the current PCSG design and an innovative adaptation of the GPS Keplerian equations. The Keplerian equation modifications allow reuse of the GPS downlink data structure and current GPS receiver hardware designs. In order to facilitate testing of the BNS system concept, Rockwell Collins has developed a prototype laboratory PL navigation system. This paper will document the laboratory demonstration system test configuration and test results. Mitigation of the PL Near/Far problem is a goal of the BNS development team. A number of PL RF pulsing schemes were investigated to determine the optimum solution for use with a standard military GPS receiver (PLGR-Precision Lightweight GPS Receiver). An enhancement program is currently underway to add a self-surveying capability to the PCSG based PL design. The Self-Surveying Pseudolite (SSPL) will be a portable PL transmitter that determines its location and then begins broadcasting PL navigation signals. A military GPS receiver, such as the PLGR, modified only with a new version of software, can use the SSPL signals as a navigational aid or as an independent SV constellation in lieu of GPS. At the completion of the enhancement program, Rockwell Collins will conduct a series of outdoor, system validation tests on the SSPL battlefield navigation system

Index Terms:
jamming   military communication   radionavigation

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Precise positioning with GPS near obstructions by augmentation with pseudolites

Stone, J.M.   Powell, J.D.
This paper appears in: **Position Location and Navigation Symposium, IEEE 1998**
04/20/1998 -04/23/1998, 20-23 Apr 1998
Location: Palm Springs, CA ,   USA
On page(s): 562-569
20-23 Apr 1998
References Cited: 20
Number of Pages: 655
INSPEC Accession Number: 6026657

Abstract:
Position information is needed in situations that have reduced availability of the GPS satellites due to obstructions which cause high elevation mask angles. Previous research has shown the advantages of pseudolites in determining the carrier cycle ambiguities and in improving the Dilution of Precision (DOP) of positioning. This paper is about the use of GPS carrier phase differential tracking for precise positioning in situations where less than 4 satellites are in view. For example, some open pit mines may have an elevation mask angle of up to 45°, thereby reducing the probability to 20% that 4 satellites are in view for a full position solution. A building near a construction site may obstruct the GPS satellites increasing the DOP beyond the tolerable limit. Pseudolites (GPS ground transmitters) may be placed to provide additional availability as well as increased accuracy. A system providing precise position information was demonstrated using differential GPS carrier phase measurements of satellite and pseudolite signals

Index Terms:
Global Positioning System   mining   satellite tracking   surveying

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